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ITEM OF INTEREST

Prepared by

Aerospace Information Division

SUBJECT: Heat Stability of Propellants: Hydrazine Perchlorate

SOURCE: Shidlovskiy, A.A., V.I. Semishin, and L.F. Shmagin. Thermal decomposition and combustion of hydrazine perchlorate. Zhurnal prikladnoy khimii, v. 35, no. 4, Apr 1962, 756-759. (S/080/62/035/004)

The thermal and combustion stabilities of hydrazine perchlorate (HP), as well as density, melting point, and heats of solution and decomposition, have been determined at the Moscow Institute of Chemical Machinery and will supplement available data on this compound. The values found for the above physicochemical properties were in good agreement with the literature, except that the melting point of HP was shown to be 140.5 - 141.0°C.

Calculations showed that the combustion temperature of HP at constant pressure was 2200°C and that 864 liters of gas and 770 kcal of heat per kg were liberated. The thermal stability of HP was much lower than that of ammonium perchlorate: weight losses due to HP decomposition after 6 min at 180, 200, 220, and 240°C were 0.3, 0.7, 3.1, and 5.4%, respectively. Rapid combustion occurred at 250°C. Flash point, determined in a Wood's alloy bath heated 20° per min from 100°C, was 277 to 283°C (cf. over 360°C for ammonium perchlorate). The addition of 5% of MnO_2 lowered the flash point of HP to 254 - 259°C, while 5% Cu_2Cl_2 caused detonation at about 170°C.

HP was more sensitive to impact than TEN and highly sensitive to friction, giving 88% detonations under a 5-kg weight dropped from 15 cm (as compared with 68% detonations for TEN) and exploding violently when lightly ground in a porcelain mortar.

Study of the combustion speed in glass tubes at room temperature and 1 atm showed that steady combustion of HP did not occur in the absence of catalysts but took place with the addition of 5% of MnO_2, CoO, or Cu_2Cl_2. Combustion speeds increased in the order $MnO_2 < CoO < Cu_2Cl_2$ (see Table). The addition of 5% $CuCl_2 \cdot 2H_2O$ did not produce steady HP combustion, but a mixture of 2.5% $CuCl_2 \cdot 2H_2O$ plus 2.5% Cu_2Cl_2 unexpectedly caused pulsating

combustion of 2/3 of the substance, followed by a violent explosion. Conditions and catalysts being the same, the combustion speed of HP was 2 to 3 times higher than that of NH_4ClO_4.

COMBUSTION OF $N_2H_4 \cdot HClO_4$ WITH CATALYTIC ADDITIVES

Inside diameter of tube, 1.05 cm; combustion speed timed with a stopwatch

Catalytic additive, 5%	Characteristics of burned samples		Test results	
	Height of column, cm	Density of material, g/cm^3	Combustion, sec	Combustion speed, cm/sec
MnO_2	1.0	1.27	7.8	0.13
	1.0	1.27	7.6	0.13
CoO	1.3	1.28	2.0	~0.7
	1.2	1.30	1.2	~1.0
Cu_2Cl_2	1.4	1.30	1.0	~1.4
	1.6	1.23	1.0	~1.6

In conclusion, it was noted that a mixture of NH_4ClO_4 with 30 to 60% of HP without catalytic additives burned steadily at 0.13 to 0.22 cm/sec in a tube 1.05 cm in (inside) diameter at room temperature and at 1 atm.

[The work reviewed in the article is a continuation of studies of the thermal decomposition and combustion of salts of ammonia and hydrazine (see AID Report 60-42).]